ON THE PRINCIPLES INVOLVED IN THE IMMEDIATE HERMETIC SEALING OF ASEPTIC WOUNDS.[1]

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It is impossible to discuss the present question without recurring *de novo* to the fundamental conditions of wound repair. The first striking contrast in the healing of wounds which interested Lord Lister in his earlier investigations was the reason why a compound fracture presented such dangerous complications, when the seeming addition to the simple fracture was only an opening through the cutaneous structures. It was easy to determine that it was not simply *per se* the superficial wound which added to the gravity of the danger. In what did it consist? The accepted answer to the question today is the addition of a certain known factor of a definite vitalized type—bacterial infection. Upon the exclusion of infective germs is based the revolution in modern surgery which has yielded such marvellous fruitage.

And yet the question may not be considered entirely settled, when distinguished practitioners like Dr. Granville Bantock, of London, and Dr. George Wilson, a prominent English medical health officer, and President of the Section of State Medicine at the annual meeting of the British Medical Association, furnish prominent addresses within the year, the keynote of which in both is that the constant presence of micro-organisms, now usually regarded as specific causes of disease, are associated with the disease only because they here find the conditions necessary for their development—that is to say, that their presence is the result rather than the cause of the pathological conditions found. So impressed with this belief is Dr. Bantock, long one of the leading surgeons of London, that he concludes his address as follows: "All these things—which are facts, not opinions, capable of demonstration and proof—go to show that the modern doctrine of bacteriology is a gigantic mistake; that we are already at the parting of the ways, and that it is safe to predict that, ere long, it will come to be recognized that these various bacilli play a beneficent rôle in the economy of Nature."

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Dr. Wilson concludes his interesting address thus: "In addition to the pathogenic microbe, there are always other conditions—conditions of soil and circumstances without which the microbe is powerless. With these conditions we can always deal more or less effectually, and our most successful efforts must always remain based on these lines."

For my own part, I am glad to have such able advocates as the above quoted authorities emphasize the proper consideration of this very important factor in wound treatment, as well as in disease, viz., the conditions of the structures with which we have to deal. Viewed from my stand-point, the consideration of the *soil* is of importance second only to that of the *seed* which may be implanted therein. Upon these two subdivisions of the question, their proper consideration and relationship, depend the whole practical deduction, the better methods of wound treatment.

With seeming singular temerity, Nature has harnessed in for constant beneficent service a variety of bacteria, the *misplacement* of which may be fraught with the direst disaster. Familiar illustrations of this are found in the life histories of the *bacillus coli communis*, which serves such an important rôle when exercising its normal function: it aids in the disintegration of the waste material within the alimentary canal. If, for any reason, unable to escape from the appendix vermiformis, its colonization within this member becomes fraught with the gravest danger.

The micrococcus albus is a constant factor from infancy to old age, aiding in the disintegration and destruction of the dying epithelial cells of the skin. *Misplaced* beneath the integuments, their development may be the cause of the most serious consequences. The hand of the surgeon, on this account, is often the most dangerous factor in operative surgery, a fact the demonstration of which has been so often repeated that few now question its importance or gravity.

Having conceded the importance of bacteria as a cause of wound infection, the evidence of which is so conclusive and convincing that few will question it, our attention is very properly called to a careful consideration of the conditions and surroundings which render their probable development a dangerous factor to the individual. The simplest illustration of favorable conditions may be cited as follows: Given a localized germ infection in well-vitalized structures, as in the prick of a finger, and note the result. A detachment of Nature's flying cohorts, the white blood-cells, are immediately summoned, surround and shut in the growing colony, and, under favorable conditions, a minute abscess is the result—the expulsion of the invaders. In a simple incised wound, in well-vitalized aseptic structures, held at rest in coaptation, these same cells form a plastic reunion, and, little by little, become changed into connective tissue cells, and the repair process is complete.

Surgical technique may be defined as the art of making in aseptic structures an aseptic wound and maintaining it aseptic. To this end note the complexity of preparatory detail for any major operation. I will grant to a critic like Dr. Bantock that there can be little question but that, in the desire of many operators for originality of technique, the average surgeon is confused with much that is of little value, and that oftentimes, in the perplexity of the multitudinous minutiæ, very important fundamental conditions are underestimated or ignored. Doubtless owing to this, more than anything else, has arisen the oft-repeated acrimonious discussions as to cleanliness in surgery, the use of antiseptics, etc.

It may be assumed that no one would claim that harm arises from a sterilized *circumfusa* of the part to be operated upon. If not harm and a possible good, any objection thereto is hypercritical. To attain this, antiseptics must be employed, and, so far as possible, heat is the most satisfactory agent. This is easily applicable, by the usual methods of steam sterilizing, to towels, instruments, etc.; in fact, everything needful, except the living structures of patient, operator and assistants.

The demonstration is now ample that we have far less to fear from the bacteria floating in the atmosphere than was formerly believed. But even now few would have the hardihood to question the dangers which may arise from a dust-laden atmosphere. Hence, cleanliness must consist, in part at least, in a clean surgery, as far as possible free from dust-laden air-currents. The integuments of a patient about the operative site must also be clean, by which I mean the removal as far as possible of every loosened epithelial cell, secretions of the sweat-ducts, as well as the extraneous material which may be attached to the skin.

For the same purpose, and really far more important, is the care which must be given to the hands of the surgeon and his assistants. Repeated experiments of the most exact and convincing character have shown without a question the danger which may ever lurk under the finger-nail of the operator, even after the most careful mechanical and chemical disinfection. It is on this account that the sterilized rubber glove comes in as one of the most important of the recent contributions to aseptic operative technique. In addition to the above, irrigation of wounds with antiseptics is still thought valuable by very many of our best operators as a further precaution for maintaining a wound aseptic.

As will be noted, I have referred to technique in something of detail, for the purpose of showing the emphasis which most surgeons make upon painstaking aseptic methods, and which I must heartily approve and consider of the first importance.

The criticism that is to follow, however, has ample justification. The surgeon must not alone be a *scientist*, which includes the familiarity with a technique as outlined, to be carried out with the automatism of a well-mastered ritual; an equal familiarity with the anatomy of the parts and their relationship; but to this should be added other almost equal acquirements, those of the *artisan* and *artist*.

There is no excuse for bungling surgery; unskilful dissection, leaving tissues shreddy and half-disorganized; devitalizing the structures by the application of dozens of strong forceps, all done in a so-called painstaking technique; and, on this account, comes the well-merited, impatient protests of great surgeons like Dr. Bantock, with a justification for the appeal that the *soil* is as important as the *seed* in every surgical procedure. Add to the above picture the application of very many ligatures, no matter how fine and cut short, almost invariably applied with a force sufficient to necrose the inclosing tissues, and we may well wonder that Nature is able, even in aseptic wounds, to rescue the work from complete destruction, much more that it goes on to primary repair. The time certainly has arisen, since, unfortunately, now every tyro in the practice of medicine has an ambition to call himself a surgeon, that an earnest protest is made against the unnecessary mutilation of the structures operated upon, and that we hold up in admiration the earlier methods of the great masters in surgery, who prided themselves upon the rapidity and skill with which they made their clean-cut wounds.

In wound technique, then, what have we to advise? A recognition of the vitalized structures with which we have to deal. To injure them by clean dissections as little as possible, to remember that even the largest vessels require comparatively little force for their occlusion, and that coaptated, well-vitalized structures, held at rest, furnish a minimum of exudates; that it is of the first importance to preserve these for the repair of the tissues; that on this account the drainage-tube has been wisely abandoned, harmful as a foreign body, liable to be the "open door" for the ingress of bacterial infection and the very means of permitting the escape of Nature's "first aid to the wounded," the vitalized serous effusions, and leucocytic proliferation.

In all large aseptic wounds it is hard to overestimate the importance of the coaptation of like structures with their retention at rest. In order to accomplish this it is of the highest importance to rejoin in a careful way the structures by the use of buried sutures, and by a general consensus of the best surgeons these sutures should be absorbable, and for many reasons I believe well selected, fine tendons furnish the preferable material. Without the actual demonstration as to cause, I have long since observed that the suture material serves a better purpose by being antiseptic rather than aseptic, and for this reason have urged the importance of soaking the tendon half an hour or more in a 1 : 1000 bichloride of mercury solution, taking the suture directly from the solution as required for use. One of the great advantages of wire is that it is impermeable. This pertains almost entirely to silkworm-gut, and scarcely in a less degree, for a considerable period, to well-selected and prepared tendon, while the *twist* in catgut and silk afford multiple recesses for foreign material.

One of the advantages of the rubber glove, of no second ary importance, is the safer handling of the suture material, since the irregular spaces of twisted sutures and ligatures, drawn through the unprotected fingers, frequently cause a dislodgement of infective epithelial cells. This, of course, pertains in a much less degree to smooth suture material, *e.g.*, wire, silkworm-gut, and tendon.

Tissues thus united by buried sutures leave no pockets for blood clots or effusions, the importance of which can scarcely be overestimated. The cleanly dissected structures, devitalized as little as possible, are best coaptated by fine continuous sutures, taken deeply through the parts from side to side which, when drawn upon, evenly coaptate the tissues and cross the line of incision at right angles, leaving no foreign material between the readjusted structures. The skin itself should be evenly coaptated by a subcuticular, continuous absorbable suture, applied in the same manner. In this way well-vitalized aseptic structures are held in even coaptation at rest. This having been effected, in aseptic wounds what further duty has the surgeon to perform to aid in the reparative process? To wit, namely, only to see that the infracted surfaces are protected during the process of repair from the invasion of bacterial infection. To this end we are all familiar with the most extraordinary, painstaking, and multiple processes of dressing devised and insisted upon as important earlier by the founder of antiseptic surgery. I think the largest criticism of modern aseptic technique in wound treatment is in following these methods. Upon this I have insisted for many years, and very possibly this paper would not have been written had not a recent visit to a number of the leading hospitals in America demonstrated to me that such methods of wound treatment were still the routine practice of many of the prominent surgeons of our country.

Permit me a single illustration. A feeble boy of perhaps eight years of age had just been operated upon for the cure of an inguinal hernia. The only criticism as to technique worthy of mention was the closure of the skin by the through-and-through interrupted silk suture, for the purpose of coaptation, the sutures, of course, subsequently to be removed. Dusted with an antiseptic absorbent powder, sterilized gauze dressings were applied in many layers. These were retained by a roller bandage, over all thick masses of cotton, and splints were applied to both legs; the little fellow mummified with bandages to double his size, reaching from navel to knees. Wherefore, asked I of the distinguished surgeon? "Of doubtful value, but it has long been the custom in this hospital."

Granting that the protection was complete, which, however, I think exceedingly doubtful in children, because of urinary and fæcal defilement; think of the torture inflicted by such methods of enforced restraint. What is the plea of the advocates of such dressings? That which pertained only recently to the retention of the drainage-tube, the escape of a possible imprisoned bacterium, and the absorption of a doubtful wound secretion, besides the prevention of ingress of extraneous material.

If our science, our theory, and practice go for anything, the making and maintaining of an aseptic wound in aseptic and well-vitalized structures is the practical issue sought and to be attained. This effected, with coaptated like structures held at rest by buried aseptic, absorbable sutures, the only factor remaining to complete our ideal technique is a dressing for the purpose of preventing subsequent infection. This is secured so simply and easily by iodoform collodion, strengthened by a few fibres of cotton, that this dressing reaches an ideal completion. It is *fluid-proof*, in that no exudate can escape from beneath it, and as a consequence it is *germ-proof*, in that by no means is it possible that any foreign material can enter the wound. Beyond this it holds in even coaptation at rest with a certain fixity of support the approximated parts. Water does not loosen it, and it is detached from the vivified cutaneous cells beneath only by the slow separation of the exfoliated epithelium. If, for any reason, it is needful to remove it, this is easily effected by soaking in alcohol or ether. The late Dr. John P. Maynard, of Dedham, first made the discovery that the cellulose of cotton fibre was soluble in ether and alcohol, and more than forty years ago gave to the profession this very valuable substance called collodion. Early it was applied for the sealing of wounds, those of a slight character oftentimes healing by primary union under its protection. It was popularly called "artificial cuticle," but naturally fell into disuse because when it covered septic wounds it was in the highest degree harmful.

Iodoform is soluble in it and is not injurious to it, and ordinarily I think it is of little additional value. Under certain conditions I believe it to be inhibitory to the development of the micrococcus albus in the proliferating epithelium, and quite as valuable in this direction as the silver salts, which are much more difficult of application. To one who may doubt the efficacy of a potent agent seemingly locked up in a collodion film we need only to cite the powerful vesiculating effect of the cantharidal collodion. A wound made and maintained aseptic in well-vitalized structures, held at rest in easy coaptation by buried tendon sutures, will be followed by a non-inflammatory primary union.

The fear, the anxiety, the constant supervision and watchfulness of nurse and attendant are entirely obviated. Wound supervision is finished before the patient leaves the surgery.

Subsequent dressing is of no avail except to keep the parts from extraneous injury. *The work of the surgeon for good or ill has its finality at the single period of manipulative intervention.*